STUDIES ON THE CHARACTERISTICS AND CHROMOSOME NUMBERS OF SOME *GLYCINE* SPP. *

by

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The cultivated soybeans belong in the species *Glycine max*. Many other species of the genus *Glycine* have been identified, but their exact classification of some species still remain in doubt. It is considered that *Glycine ussuriensis* Regel and Maack and *Glycine gracilis* Skvortzov are closely related to the cultivated soybeans, *G. max*. The species *G. ussuriensis*, which has slender plant with twinning habit of growth, purple flower, oblong, small, hard, sooty, black seed, grows wild in Korea, northern part of Japan and northeastern Provinces of China and which has been believed to be the progenitor of the cultivated forms. The species *G. gracilis*, which has a low-growing plant, slender stem with smaller trifoliate leaves in comparision with the cultivated species, grows in northeastern Provinces of China, and has the intermediate characteristics between both *G. ussuriensis* and *G. max*. In addition to the two species mentioned above, it was also wildely accepted that *Glycine formosana* Hosokawa, is one of the *Glycine* species found in subtropical Taiwan, and was considered as one of the most closely related varieties to the cultivated forms. According to Tang and Lin[2] in their late paper, the *G.formosana* is very similar to the *G. ussuriensis* in morphological characteristics, they are but ecotypes of same species. All the three species grow annually containing 40 somatic chromosomes. The materials used in this study are perennial, origionally collected from Australia, Africa, South America, Sudan, and India.

Materials and Methods

Twenty strains of seven wild species in the genus *Glycine* were used in this study. The seeds were furnished by U. S. Regional Soybean Laboratory in Urbana, Illinois, upon the author's special request in 1960. The name of species, strain numbers and the sources of origin are listed below:

Species	Strain no.	Source of origin
Glycine borianii Baker	PI 249680	Sudan
Glycine clandestina Wendl	PI 233138	Australia
Glycine falcata Benth	PI 246591	Australia

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Glycine javanica L.	PI 156055	Southern Rhodesia
Glycine javanica L.	PI 213256	India
Glycine javanica L.	PI 213257	India
Glycine javanica L.	PI 224979	South Africa
Glycine javanica L.	PI 224980	Southern Rhodesia
Glycine javanica L.	PI 224981	Southern Rhodesia
Glycine javanica L.	PI 230325	South Africa
Glycine javanica L.	PI 234874	Congo
Glycine javanica L.	PI 234876	Congo
Glycine javanica L.	PI 245005	Uganda
Glycine javanica L.	PI 247676	Congo
Glycine javanica L.	PI 258381	Africa
Glycine javanica L.	PI 259546	Brazil
Glycine javanica L.	FC 32821	Unknown
Glycine tabacina Benth	PI 193232	Australia
Glycine tomentella Hayata	PI 233051	Taiwan, China
Glycine tomentosa Benth	PI 253238	Australia

The items of research in this study included morphological characters, growth habit, and the determining the chromosome numbers of the wild species. The seeds of each strain were sown in pots respectively on July 21, 1961. In order to overcome the hardseededness of the wild species, all seeds were given a scarifying treatment by chipping a small portion of the seed coat with a needle so as to facilitate the penetration of water and germination of seeds. For the study on the characteristics, 20 days after the seedling emerged from soil, four seedlings of each strain were transplanted in pots separately. The chromosome numbers of some strains of the wild species were determined by counts from pollen mother cells while some others from both root-tips and pollen mother cell smears. The flower buds were killed and fixed in a 3: 1 solution of 95% ethyl alcohol and glacial acetic acid for about 30 minutes and stored in 70% alcohol. The root-tips were collected from germinating seeds and fixed immidiately in 3:1 acetic-alcohol fixative, and stained with aceto-carmine when the pollen mother cell smears and root-tip smears.

Results

The wild species of the genus *Glycine* have the general characters of Leguminosae, but in some characters, they are quite different. In comparision with the cultivated species, *G. max*, greater differences were found in some characters in the wild species. Those have the greatest difference in the characters of the wild forms reported in this paper are all perennial plants except *G. borianii*. They could grow perennially under the natural environment of Taiwan. The flowering of the wild species lasted a long period, and the flowering dates of some strains scattered in the long period,if temperature changes rapidly. The maturity of seeds of some

Table 1. The chracteristics of some *Glycine* spp.

Species	Strain no.	Flower color	Leaflet shape	Pubscence	
				Type	Color
G. borianii	PI 249680	Pink	Lanceolate	Appressed	Gray
G. clandestina	PI 233138	Purple	Linear	Puberulent	Tawny
G. falcata	PI 246591	Dilute purple	Lanceolate	Appressed	Gray
G. javanica	FC 32821	White (PT)*	Oval	Appressed	Tawny
G. javanica	PI 156055	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 213256	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 213257	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 224979	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 224980	White (LGT)**	Oval	Appressed	Tawny
G. javanica	PI 224981	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 230325	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 234874	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 234876	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 245005	White (PT)	Oval	Appressed	Tawny
G. jaaanica	PI 247676	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 258381	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 259546	White (PT)	Oval	Appressed	Gray
G. tabacina	PI 193232	Dark purple	Obovate, Lanceolate	Puberulent	Tawny
G. tomentella	PI 233051	Dark purple	Elliptic	Normal	Tawny
G. tomentosa	PI 253238	Purple	Oval	Appressed	Tawny

Strain no.	Growth habit	Annual or perennial	Seed coat color	No. of seeds per pod	Weight per 100 seeds (g)	Days to flower	Days to maturity
PI 249680	Climbing	Annual	Buff, Brown	2	1.31	99	154
PI 233138	Twinning	Perennial	Dark brown	2-8	0.30	51	109
PI 246591	Weak climbing	Perennial	Black	1-4	1.48	54	143
FC 32821	Twinning	Perennial	Light brown	1-6	0.86	105	190-207
PI 156055	Twinning	Perennial	Dark brown	2-7	0.93	107	190-207
PI 213256	Twinning	Perennial	Light brown	2-6	0.84	117	190-241
PI 213257	Twinning	Perennial	Light brown	1-6	0.78	117	190-218
PI 224979	Twinning	Perennial	Brown	1-7	0.85	115	190-258
PI 224980	Twinning	Perennial	Light brown	2-5	1.27	98	159-227
PI 224981	Twinning	Perennial	Dark brown	1-7	0.94	111	190-258
PI 230325	Twinning	Perennial	Dark brown	2-6	0.88	75	135-200
PI 234874	Twinning	Perennial	Brown	1-7	0.63	115	190-246
PI 234876	Twinning	Perennial	Light brown	1-7	0.78	113	190-241
PI 245005	Twinning	Perennial	Brown	1-6	0.75	124	190-218
PI 247676	Twinning	Perennial	Dark brown	1-6	0.55	118	190-258
PI 258381	Twinning	Perennial	Light brown	2-7	0.77	118	190-218
PI 259546	Twinning	Perennial	Dark brown	2-5	1.00	99	161-213
PI 193232	Climbing	Perennial	Black brown	1-5	0.56	90	138-205
PI 233051	Climbing	Perennial	Dark brown	2-5	0.70	73	120-184
PI 253238	Twinning	Perennial	Dark brown	2-5	0.65	60	102-151

* White (PT)=White flower with purple throat.

** White (LGT)=White flower with light green throat.

wild forms were not uniform for their long flowering period. Consequently, in many strains, harvesting of seeds dividing into several times. The growth habit of twinning or climbing stems was found in all the wild species. At the seedling stage they grew slowly and then became very vigorous after this stage, especially so in the species *G. javanica* and *G. tomentosa*. Although the species *G. clandestina* had very small leaves and fine stem, its twinning habit was strong after seedling stage. Besides the characters mentioned above, the wild forms had small, hard, dark-colored seed, black or brown pod, 2-8 seeded-pod. The plant characters in detail are shown in Table 1, Fig. 1, 2, and 3.

The determination of chromosome numbers in the wild species were made by counts from pollen mother cell smear. or from both pollen mother cell and root-tip smears. The species *G. tomentosa*, *G. falcata* and *G. clandestina* had the same chromosomes numbers being n=20; both of the species*G. tabacina* and *G. tomentella* had the same chromosome numbers being n=40. In the population of *G. javanica*, 14 strains were used in this study for chromosome counts, seven out of fourteen strains had n=11 chromosomes, the other sevenstrains had double chromosome numbers being n=22. The species *G. borianii* hadn=11 chromosomes in pollen mother cells, and 2n=22 chromosomes by countsobtained from root-tip smears. The name of species, strain number, chromosome numbers and the photomicrographs of pollen mother cells and root-tip cells areshown in Table 2 and Fig. 3 respectively.

Table 2. The chromosome numbers of some *Glycine* spp.

Species	Strain no.	Chromosome no.
G. boaianii	PI 249680	n=11; 2n=22
G. clandestina	PI 233138	n=20
G. falcata	PI 246591	n=20
G. javanica	FC 32821	n=22
G. javanica	PI 156055	n=22
G. javanica	PI 213256	n=11
G. javanica	PI 213257	n=11; 2n=22
G. javanica	PI 224979	n=22
G. javanica	PI 224980	n=11
G. javanica	PI 224981	n=11
G. javanica	PI 230325	n=11
G. javanica	PI 234874	n=22
G. javanica	PI 234876	n=22
G. javanica	PI 245005	n=11
G. javanica	PI 247676	n=22
G. javanica	PI 258381	n=11
G. javanica	PI 259546	n=22

G. tabacina	PI 193232	n=40
G. tomentella	PI 233051	n=40
G. tomentosa	PI 253238	n=20

Discusion

Seven wild species in the genus *Glycine* were used in this study. On the comparative study of the characteristics among the *Glycine* spp., their qualitative characters had little variations. The pubescence type, color, and flower color of the wild species were similar to that of the cultivated forms. On the other hand, the quantitative characters, such as flowering date and period, maturity and the weight per 100 seeds, had significant variations either among the wild species or between the wild and cultivated forms. Significant differences in the quantitative characters within the population of *G. javanica* were found.

The chromosome counts were made on aceto-carmine smears in meiotic or meitotic stage. Among the seven wild species in this study, *G. falcata*, *G. clandestina* and *G. tomentosa*, had the same chromosome number, n=20. The basic number of chromosome of the genus *Glycine* is x=10. Therefore the three species of n=20 sould be diploid forms. *G. tabacina* and *G. tomentella*, had n=40 chromosomes, should be tetraploid forms. In the population of *G. javanica*, 14 strains were used for chromosome counts, among which seven strains had n=11 chromosomes while the other seven strains had n=22 chromosomes. The strain PI 249680 of the species *G. borianii* also had n=11 chromosomes. In general, good fertility were obtained in the strains of both *G. javanica* and *G. borianii*. Therefore, there may be some uncertainties whether in the classification or in the basic number of chromosome in the genus *Glycine*. Especially the basic number of chromosome of *G. javanica* and *G. borianii*, is a very interesting problem, pending further study.

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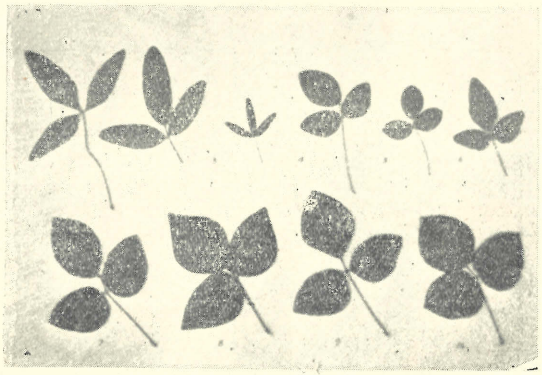
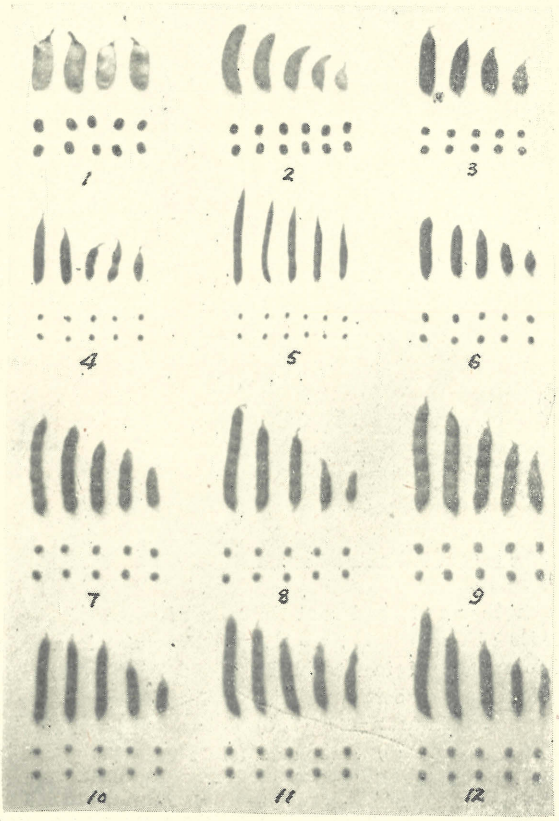
Fig. 1. The plants of some *Glycine* spp. (A) *Glycine tabacina*, PI 193232. (B) *Glycine borianii*, PI 249680. (C) *Glycine tomentosa* PI 253238. (D) *Glycine clandestina* PI 233138. (E) *Glycine tomentella*, PI 233051. (F) *Glycin falcata*, PI 230983. (G) *Glycine javanica*, FC 32821. (H) *Glycine javanica*, PI 156055. (I) *Glycine javanica*, PI 213256. (J) *Glycine javanica*, PI 213257.



(1) *G. falcata*
(2) *G. borianii*
(3) *G. clandestina*
(4) *G. tomentosa*
(5) *G. tabacina*
(6) *G. tomentella*
(7-10) *G. javanica*

Fig. 2. The leaf shape of some *Glycine* spp.



(1) *G. borianii*
(2) *G. falcata*
(3) *G. tomentosa*
(4) *G. tabacina*
(5) *G. clandestina*
(6) *G. tomentella*
(7) *G. javanica*, PI 259546
(8) *G. javanica*, PI 224979
(9) *G. javanica*, PI 224980
(10) *G. javanica*, PI 234874
(11) *G. javanica*, PI 247676
(12) *G. javanica*, PI 224981

Fig. 3. The shapes of pod and seed of some *Glycine* spp.

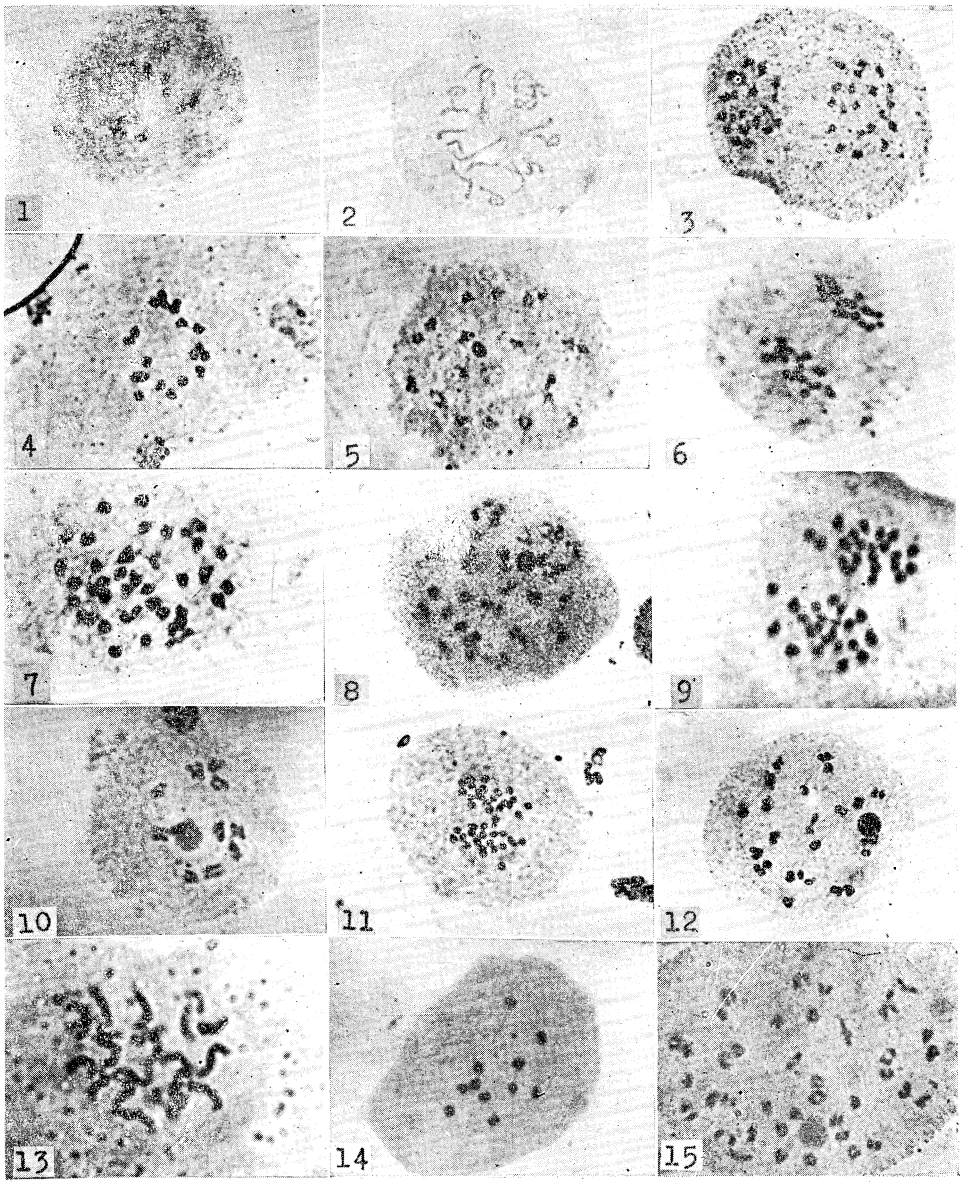


Fig. 4. The photomicrographs of pollen mother cells and root-tip cells of some *Glycine* spp. (1) Metaphase I in strain PI 249680 of *G. lorianii*, n=11. (2) Prophase in a root-tip cell of PI 249680, 2n=22. (3) Metaphase II in strain PI 233138 of *G. clandestina*, n=20. (4, 5) Metaphase I and diakinesis in strain PI 253238 of *G. tomentosa*, n=20. (6) Anaphase I in strain PI 246591 of *G. falcata*, n=20 (7, 8) Metaphase I and diakinesis in strain PI 193232 of *G. tabacina*, n=40. (9) Anaphase I in strain FC 32821 of *G. javanica*, n=22. (10) Diakinesis in strain PI 213256 of *G. javanica*, n=11. (11) Anaphase I in strain PI 156055 of *G. javanica*, n=22. (12) Diakinesis in strain PI 238744 of *G. javanica*, n=22. (13) Metaphase in a root-tip cell of strain PI 213257 of *G. javanica*, 2n=22. (14) Metaphase I in strain PI 230325, n=11. (15) Diakinesis in strain PI 233051 of *G. tomentella*, n=40.

大豆野生種染色體數目及植物性狀之研究

鄭　玉　威

摘　　要

本研究供試大豆屬野生種，係由美國聯邦大豆地區試驗所 (U. S. Regional Soybean Laboratory) 所分贈，供試材料包括 7 個 Species 共計 20 個品系，計有 *Glycine borianii*, *Glycine clandestina*, *Glycine falcata*, *Glycine javanica*, *Glycine tabacina*, *Glycine tomentella* 及 *Glycine tomentosa*。其中 *G. javanica* 供試品種有 14 品系。其研究方法爲分別調查現有收集大豆屬野生種之植物形態，生長，繁殖，以及利用 Smear method 用 Aceto-carmine 染色，檢查花粉母細胞或根端細胞，以確定其染色體數目。

本研究應用之各大豆屬野生種，均有豆科植物通性，與大豆栽培種比較，有顯著差別，本研究所用之野生種，除 *G. borianii* 外其餘具有多年生習性，在臺灣之自然環境下，可作多年生生長，開花期長而零散，似受氣溫影響而變化甚大，豆莢成熟期多不整齊，多數品系種子均分成數期採收。

各野生種均具有强烈蔓生攀緣成葡萄習性。苗期生長緩慢，後期生長勢强，其中尤以 *G. javanica*, *G. tomentosa* 最强；*G. clandestina* 莖葉極爲細小，後期生長旺盛。各野生種種子粒小，豆莢爲黑或褐色，每莢種子爲 2～8 粒不等，種皮黑或褐色，其染色體數目列簡表如下：

種　　名	染　色　體　數
G. borianii	n=11；2n=22 (根端細胞檢查)
G. clandestina	n=20
G. falcata	n=20
G. javanica	7 個品系 n=11；7 個品系 n=22
G. tabacina	n=40
G. tomentella	n=40
G. tomentosa	n=20